UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 6
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MEMORANDUM

SUBJECT: Protective Concentration Levels proposed in the draft Feasibility Study for the San Jacinto Waste Pits site

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TO: Gary Miller
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The draft Feasibility Study for the San Jacinto Waste Pits site proposed four Protective Concentration Levels (PCLs), previously developed in the Baseline Human Health Risk Assessment and the Remedial Investigation Report, as the basis for potential Preliminary Clean-up Goals. Dioxins/Furans were determined to be risk drivers in all media evaluated. All of the PCLs used in the evaluation of alternatives are based on $TEQ_{DF,M}$ concentrations that are protective of human health, based on the Reasonable Maximum Exposure (RME) scenario for the subject hypothetical receptors:

- Hypothetical recreational visitor: HQ of 1 $TEQ_{DF,M}$ = 220 ng/kg; developed for sediments in the area north of I-10 outside the footprint of TCRA cap and within USEPA's Preliminary Site Perimeter.
- Hypothetical future recreational visitor: HQ of 1 $TEQ_{DF,M}$ = 1,300 ng/kg; developed for soils in the area north of I-10 inside USEPA's Preliminary Site Perimeter.
- Hypothetical future outdoor commercial worker: HQ of 1 $TEQ_{DF,M}$ = 1,300 ng/kg; developed for soils and sediments in the area north of I-10 inside the footprint of the TCRA cap and for soils in the area south of I-10.
- Hypothetical future construction worker: HQ of 1 $TEQ_{DF,M}$ = 450 ng/kg; developed for soils in the area south of I-10 (0-10 feet bgs).

Additional PCLs were also developed in the BHHRA and RI Report, however, were not included in the FS evaluation of alternatives:

- Hypothetical subsistence fisher: developed for sediments north of I-10, however, exposure assumptions are not consistent with the anticipated future uses within USEPA's Preliminary Site Perimeter.

- Hypothetical recreational fisher: developed for sediments in the area north of I-10, but not considered in the evaluation of alternatives because the Hypothetical Recreational Visitor (above) is a more conservative PCL.
- PCLs for total PCBs and arsenic in soil and sediments did not exceed the Excess Lifetime Cancer Risk of 1×10^{-4} for all receptors.
- Elevated mercury levels found in the soils on the upland sand separation area are higher than in the wastes within the Northern Impoundments, indicating that elevated mercury concentrations are not related to paper mill waste.
- Tissue PCLs were also developed in the Risk Assessment and RI Report for hardhead catfish, common Rangia clams and blue crab.

Non-cancer and cancer risk PCLs were developed for all evaluated COPCs, media and hypothetical receptors following USEPA methods (except cancer risk for dioxins/furans) and using most USEPA exposure assumptions. Some exposure assumptions were developed site-specifically. Cancer risks for dioxins/furans were developed as a $TEQ_{DF,M}$ hazard index based on a total daily intake (TDI) method rather than use of a cancer slope factor. Non-cancer hazard was generally more conservative than cancer hazard for dioxins/furans. Summary tables of calculated risks and PCLs were extracted from the RI Report and are provided in Attachment A. Summary tables of cancer and non-cancer $TEQ_{DF,M}$ PCLs and exposure assumptions were extracted from the RI Report and are provided in Attachment B. An extract from the RI Report, describing PCL calculations, is provided in Attachment C.

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Table 5-24
Hazards and Risks for the Hypothetical Recreational Fisher Scenarios

Scenario	Noncancer HI		Cancer Risk		$TEQ_{DF,M}$ Cancer HI	
	RME	CTE	RME	CTE	RME	CTE
1A - Direct exposure Beach Area A; Ingestion of catfish from FCA2/3	2	0.3	$1x10^{-5}$	$6x10^{-7}$	0.3	0.04
1B - Direct exposure Beach Area A; Ingestion of clam from FCA 1/3	0.04	0.005	$6x10^{-7}$	$3x10^{-8}$	0.006	0.0007
1C - Direct exposure Beach Area A; Ingestion of crab from FCA 2/3	0.03	0.002	$5x10^{-7}$	$2x10^{-8}$	0.001	0.0001
2A - Direct exposure Beach Area B/C; Ingestion of catfish from FCA2/3	2	0.3	$1x10^{-5}$	$7x10^{-7}$	0.3	0.04
2B - Direct exposure Beach Area B/C; Ingestion of clam from FCA 2	0.3	0.01	$3x10^{-6}$	$9x10^{-8}$	0.07	0.003
2C - Direct exposure Beach Area B/C; Ingestion of crab from FCA2/3	0.08	0.006	$3x10^{-6}$	$9x10^{-8}$	0.007	0.0004
3A - Direct exposure Beach Area E; Ingestion of catfish from FCA2/3	50	0.6	$2x10^{-5}$	$7x10^{-7}$	10	0.1
3B - Direct exposure Beach Area E; Ingestion of clam from FCA 2	40	0.3	$1x10^{-5}$	$2x10^{-7}$	10	0.08
3C - Direct exposure Beach Area E; Ingestion of crab from FCA2/3	40	0.3	$1x10^{-5}$	$2x10^{-7}$	10	0.08
4A - Direct exposure Beach Area D; Ingestion of catfish from FCA 1	2	0.3	$1x10^{-5}$	$7x10^{-7}$	0.3	0.03
4B - Direct exposure Beach Area D; Ingestion of clam from FCA 1/3	0.08	0.008	$3x10^{-6}$	$1x10^{-7}$	0.008	0.0008
4C - Direct exposure Beach Area D; Ingestion of crab from FCA 1	0.08	0.006	$2x10^{-6}$	$1x10^{-7}$	0.006	0.0005

Notes

Shaded cells indicate that noncancer HI is >1, cancer risk is $>1x10^{-4}$, or $TEQ_{DF,M}$ cancer HI is >1.

CTE = central tendency exposure

FCA = fish collection area

HI = hazard index

RME = reasonable maximum exposure

$TEQ_{DF,M}$ = Toxicity equivalent concentration calculated using only dioxin and furan congeners using mammalian toxicity equivalency factors (Van den Berg et al. 2006).

Table 5-25
Hazards and Risks for the Hypothetical Subsistence Fisher Scenarios

Scenario	Noncancer HI	Cancer Risk	$TEQ_{DF,M}$ Cancer HI
1A - Direct exposure Beach Area A; Ingestion of catfish from FCA 2/3	20	$1x10^{-4}$	3
1B - Direct exposure Beach Area A; Ingestion of clam from FCA 1/3	0.5	$5x10^{-6}$	0.08
1C - Direct exposure Beach Area A; Ingestion of crab from FCA 2/3	0.2	$3x10^{-6}$	0.01
2A - Direct exposure Beach Area B/C; Ingestion of catfish from FCA 2/3	20	$1x10^{-4}$	3
2B - Direct exposure Beach Area B/C; Ingestion of clam from FCA 2	3	$1x10^{-5}$	0.9
2C - Direct exposure Beach Area B/C; Ingestion of crab from FCA 2/3	0.4	$9x10^{-6}$	0.03
3A - Direct exposure Beach Area E; Ingestion of catfish from FCA 2/3	100	$1x10^{-4}$	38
3B - Direct exposure Beach Area E; Ingestion of clam from FCA 2	100	$3x10^{-5}$	36
3C - Direct exposure Beach Area E; Ingestion of crab from FCA 2/3	100	$3x10^{-5}$	35
4A - Direct exposure Beach Area D; Ingestion of catfish from FCA 1	20	$1x10^{-4}$	3
4B - Direct exposure Beach Area D; Ingestion of clam from FCA 1/3	0.6	$1x10^{-5}$	0.08
4C - Direct exposure Beach Area D; Ingestion of crab from FCA 1	0.5	$9x10^{-6}$	0.05

Notes

Shaded cells indicate that noncancer HI is >1, cancer risk is $>1x10^{-4}$, or TEQ_{DF} cancer HI is >1.

FCA = fish collection area

HI = hazard index

$TEQ_{DF,M}$ = Toxicity equivalent concentration calculated using only dioxin and furan congeners using mammalian toxicity equivalency factors (Van den Berg et al. 2006).

Table 5-26
Hazards and Risks for the Hypothetical Recreational Visitor Scenarios

	Noncancer HI		Cancer Risk		$TEQ_{DF,M}$ Cancer HI	
	RME	CTE	RME	CTE	RME	CTE
Scenario 1 - Direct exposure Beach Area A	0.06	0.001	$8x10^{-7}$	$2x10^{-8}$	0.006	7E-05
Scenario 2 - Direct exposure Beach Area B/C	0.1	0.008	$4x10^{-6}$	$2x10^{-7}$	0.01	0.0007
Scenario 3 - Direct exposure Beach Area E	60	0.6	$1x10^{-5}$	$3x10^{-7}$	20	0.2
Scenario 4 - Direct exposure Beach Area D	0.1	0.007	$3x10^{-6}$	$2x10^{-7}$	0.008	0.0003

Notes

Shaded cells indicate that noncancer HI is >1, cancer risk is $>1x10^{-4}$, or TEQ_{DF} cancer HI is >1.

CTE = central tendency exposure

HI = hazard index

RME = reasonable maximum exposure

$TEQ_{DF,M}$ = Toxicity equivalent concentration calculated using only dioxin and furan congeners using mammalian toxicity equivalency factors (Van den Berg et al. 2006).

Table 5-29
Protective Concentration Levels for $TEQ_{DF,M}$ in Sediment

COC	Units	Cancer Hazard Quotient = 1		Noncancer Hazard Quotient = 1	
		CTE	RME	CTE	RME
Hypothetical Recreational Fisher					
$TEQ_{DF,M}$	ng/kg dw	11,000	980	3,500	300
Hypothetical Subsistence Fisher					
$TEQ_{DF,M}$	ng/kg dw	NA	370	NA	110
Hypothetical Recreational Visitor					
$TEQ_{DF,M}$	ng/kg dw	5,700	740	1,700	220

Notes

COC = chemical of concern

CTE = central tendency exposure

dw = dry weight

NA = central tendency exposure (CTE) not applicable for Subsistence Fisher

RME = reasonable maximum exposure

TCDD = tetrachlorodibenzo-*p*-dioxin

$TEQ_{DF,M}$ (ND=1/2DL) = Toxicity equivalent for TCDD calculated for dioxins and furans using mammalian toxicity equivalency factors (Van den Berg et al. 2006) with nondetects set at one-half the detection limit.

Table 5-30

Protective Concentration Levels for Total PCBs and Arsenic in Sediment

COC	Exposure Level	Units	Cancer Risk			Noncancer Hazard
			$1x10^{-4}$	$1x10^{-5}$	$1x10^{-6}$	Hazard Quotient = 1
Hypothetical Recreational Fisher						
Total PCBs	RME	µg/kg dw	18,000	1,800	180	2,000
	CTE	µg/kg dw	700,000	70,000	7,000	21,000
Arsenic	RME	mg/kg dw	110	11	1.1	130
	CTE	mg/kg dw	2,200	220	22	1,500
Hypothetical Subsistence Fisher						
Total PCBs	RME	µg/kg dw	6,600	660	66	750
Arsenic	RME	mg/kg dw	40	4.0	0.40	48
Hypothetical Recreational Visitor						
PCBs	RME	µg/kg dw	13,000	1,300	130	1,500
	CTE	µg/kg dw	350,000	35,000	3,500	11,000
Arsenic	RME	mg/kg dw	79	7.9	0.79	6.4
	CTE	mg/kg dw	1,100	110	11	750

Notes

COC = chemical of concern

CTE = central tendency exposure

dw = dry weight

PCB = polychlorinated biphenyl

RME = reasonable maximum exposure

Table 5-31
Protective Concentration Levels for $TEQ_{DF,M}$ in Soil for the Hypothetical Recreational Visitor

COC	Units	Cancer Hazard Quotient = 1		Noncancer Hazard Quotient = 1	
		CTE	RME	CTE	RME
$TEQ_{DF,M}$	ng/kg dw	230,000	4,300	69,000	1,300

Notes

COC = chemical of concern

CTE = central tendency exposure

dw = dry weight

RME = reasonable maximum exposure

TCDD = tetrachlorodibenzo-*p* -dioxin

$TEQ_{DF,M}$ (ND=1/2DL) = Toxicity equivalent for TCDD calculated for dioxins and furans using mammalian toxicity equivalency factors (Van den Berg et al. 2006) with nondetects set at one-half the detection limit.

Table 5-32

Protective Concentration Levels for Total PCBs and Arsenic in Soil for the Hypothetical Recreational Visitor

COC	Exposure Level	Units	Cancer Risk			Noncancer Hazard
			$1x10^{-4}$	$1x10^{-5}$	$1x10^{-6}$	Hazard Quotient = 1
Total PCBs	RME	µg/kg dw	310,000	31,000	3,100	16,000
	CTE	µg/kg dw	18,000,000	1,800,000	180,000	560,000
Arsenic	RME	mg/kg dw	1,100	110	11	560
	CTE	mg/kg dw	43,000	4,300	430	30,000

Notes

COC - chemical of concern

CTE = central tendency exposure

dw = dry weight

PCB = polychlorinated biphenyl

RME = reasonable maximum exposure

Table 5-33
Protective Concentration Levels for $TEQ_{DF,M}$ in Tissue

COC	Units	Cancer Hazard = 1		Noncancer Hazard Quotient = 1	
		CTE	RME	CTE	RME
Hypothetical Recreational Fisher—Catfish Fillet					
$TEQ_{DF,M}$	ng/kg ww	88	12	27	3.8
Hypothetical Subsistence Fisher—Catfish Fillet					
$TEQ_{DF,M}$	ng/kg ww	NA	1.5	NA	0.44
Hypothetical Recreational Fisher—Clams					
$TEQ_{DF,M}$	ng/kg ww	1840	290	560	89
Hypothetical Subsistence Fisher—Clams					
$TEQ_{DF,M}$	ng/kg ww	NA	22	NA	6.7

Notes

COC = chemical of concern

CTE = central tendency exposure

NA = central tendency exposure (CTE) not applicable for Subsistence Fisher

RME = reasonable maximum exposure

TCDD = tetrachlorodibenzo-*p*-dioxin

$TEQ_{DF,M}$ (ND=1/2DL) = Toxicity equivalent for TCDD calculated for dioxins and furans using mammalian toxicity equivalency factors (Van den Berg et al. 2006) with nondetects set at one-half the detection limit.

ww = wet weight

Table 5-34

Protective Concentration Levels for Total PCBs, Arsenic, and Mercury in Tissue

COC	Exposure Level	Units	Cancer Risk			Noncancer Hazard
			$1x10^{-4}$	$1x10^{-5}$	$1x10^{-6}$	Hazard Quotient = 1
Hypothetical Recreational Fisher—Catfish Fillet						
Total PCBs	RME	µg/kg ww	1,200	120	12	110
	CTE	µg/kg ww	25,000	2,500	250	760
Arsenic	RME	mg/kg ww	16	1.6	0.16	16
	CTE	mg/kg ww	170	17	1.7	110
Mercury	RME	mg/kg ww	NA	NA	NA	0.54
	CTE	mg/kg ww	NA	NA	NA	3.8
Hypothetical Recreational Fisher— Shellfish						
Total PCBs	RME	µg/kg ww	23,000	2,300	230	2,500
	CTE	µg/kg ww	520,000	52,000	5,200	16,000
Arsenic	RME	mg/kg ww	300	30	3.0	380
	CTE	mg/kg ww	3,500	350	35	2,400
Mercury	RME	mg/kg ww	NA	NA	NA	13
	CTE	mg/kg ww	NA	NA	NA	80
Hypothetical Subsistence Fisher—Catfish Fillet						
Total PCBs	RME	µg/kg ww	130	13	1.3	13
Arsenic	RME	mg/kg ww	1.7	0.17	0.017	1.9
Mercury	RME	mg/kg ww	NA	NA	NA	0.063
Hypothetical Subsistence Fisher—Shellfish						
Total PCBs	RME	µg/kg ww	1,600	160	16	190
Arsenic	RME	mg/kg ww	22	2.2	0.22	29
Mercury	RME	mg/kg ww	NA	NA	NA	0.95

Notes

COC = chemical of concern

CTE = central tendency exposure

NA = CTE not applicable for Subsistence Fisher

PCB = polychlorinated biphenyl

RME = reasonable maximum exposure

ww = wet weight

Table 6-17
Summary of Baseline Hazards and Risks for the Area of Investigation on the Peninsula South of I-10

	Noncancer HI		Cancer Risk		$TEQ_{DF,M}$ Cancer HI	
	RME	CTE	RME	CTE	RME	CTE
Hypothetical Trespasser - Direct exposure to soils	6E-03	4E-04	2E-07	9E-09	2E-04	2E-05
Hypothetical Commercial Worker - Direct exposure to soils	2E-01	4E-02	3E-05	3E-06	6E-03	2E-03
Hypothetical Construction Worker, Scenario 1 - Direct exposure to soils	5E+00	1E+00	3E-07	5E-08	2E+00	3E-01
Hypothetical Construction Worker, Scenario 2 - Direct exposure to soils	2E+01	4E+00	3E-07	6E-08	7E+00	1E+00
Hypothetical Construction Worker, Scenario 3 - Direct exposure to soils	4E-01	8E-02	3E-06	5E-07	4E-03	7E-04
Hypothetical Construction Worker, Scenario 4 - Direct exposure to soils	2E+01	3E+00	1E-06	2E-07	5E+00	1E+00
Hypothetical Construction Worker, Scenario 5 - Direct exposure to soils	1E+00	2E-01	9E-08	2E-08	4E-01	7E-02

Notes

Shaded cells indicate noncancer HI >1, cancer risk >1E-04, or $TEQ_{DF,M}$ cancer HI >1.

CTE = central tendency exposure
HI = hazard index
RME = reasonable maximum exposure
$TEQ_{DF,M}$ = toxicity equivalent for dioxins and furans using toxicity equivalency factors for mammals

Table 6-18
Hypothetical Future Construction Worker PCLs for $TEQ_{DF,M}$

Noncancer Hazard Quotient = 1 (ng/kg dw)		Cancer Hazard Quotient = 1 (ng/kg dw)	
RME	CTE	RME	CTE
450	2,500	1,500	8,200

Notes

CTE = central tendency estimate
dw = dry weight
PCL = protective concentration level
RME= reasonable maximum exposure
$TEQ_{DF,M}$ = toxicity equivalent for dioxins and furans using toxicity equivalency factors for mammals

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Table H5
Cancer Hazard Based PCLs for $TEQ_{DF,M}$ in Sediment for Hazard Index of 1, RME Scenario

Parameter		Units	Hypothetical Recreational Fisher	Hypothetical Subsistence Fisher	Hypothetical Recreational Visitor
Common Parameters					
Exposure duration (young child)	ED	years	6	6	6
Body weight (young child)	BW	kg	19	19	19
Averaging time - carcinogenic (young child)	AT_c	days	2,190	2,190	2,190
Pathway Specific Parameters					
Incidental Ingestion of Sediment					
Ingestion rate, sediment (young child)	IR_{sed}	mg/day	125	125	125
Fraction of intake that is site-related	$FI_{soil\text{-}sed}$	% as fraction	1.00	1.00	1.00
Fraction of total intake that is sediment	F_{sed}	% as fraction	1.00	1.00	0.50
Relative bioavailability adjustment for soil and sediment	RBA_{ss}	% as fraction	0.50	0.50	0.50
Conversion factor	CF_1	kg/mg	1E-06	1E-06	1E-06
Exposure frequency, soil-sediment	$EF_{soil\text{-}sed}$	days/year	39	104	104
Daily Intake Factor - carcinogenic (ingestion)	$I_{factor\text{-}sed\text{-}i}$	$days^{-1}$	3.5E-07	9.4E-07	4.7E-07
Dermal Contact with Sediment					
Dermal adherence factor, sediment (young child)	AF_{sed}	mg/cm^2	3.6	3.6	3.6
Skin surface area exposed (young child)	SA	cm^2/day	3,280	3,280	3,280
Fraction of intake that is site-related	$FI_{soil\text{-}sed}$	% as fraction	1.00	1.00	1.00
Fraction of total intake that is sediment	F_{sed}	% as fraction	1.00	1.00	0.50
Dermal absorption factor for soil and sediment	ABS_d	% as fraction	0.03	0.03	0.03
Conversion factor, dermal con (kg/mg)	CF_1	kg/mg	1.E-06	1.E-06	1.E-06
Exposure frequency, soil-sediment	$EF_{soil\text{-}sed}$	days/year	39	104	104
Daily Intake Factor - carcinogenic (dermal)	$I_{factor\text{-}sed\text{-}d}$	$days^{-1}$	2.0E-06	5.3E-06	2.7E-06
CARCINOGENIC			**Child**	**Child**	**Child**
Daily Intake Factor, dermal contact $(days)^{-1}$			2.0E-06	5.3E-06	2.7E-06
Daily Intake Factor, sediment ingestion $(days)^{-1}$			3.5E-07	9.4E-07	4.7E-07
Tolerable Daily Intake (TDI) (mg/kg-day)			2.30E-09	2.30E-09	2.30E-09
Conversion Factor (ng/mg)			1.00E+06	1.00E+06	1.00E+06
Target Hazard Quotient			1	1	1
PCL Sediment (ng/kg)			**981**	**368**	**736**

Table H7

Cancer Hazard Based PCLs for $TEQ_{DF,M}$ in Soil for Hazard Index of 1, RME Scenario

Parameter		Units	Hypothetical Recreational Visitor
Common Parameters			
Exposure duration (young child)	ED	years	6.0
Body weight (young child)	BW	kg	19
Averaging time - carcinogenic (young child)	AT_c	days	2,190
Pathway Specific Parameters			
Incidental Ingestion of Soil			
Ingestion rate, soil (young child)	IR_{soil}	mg/day	125
Fraction of intake that is site-related	$FI_{soil\text{-}sed}$	% as fraction	1.00
Fraction of total intake that is soil	F_{soil}	% as fraction	0.50
Relative bioavailability adjustment for soil and sediment	RBA_{ss}	% as fraction	0.50
Conversion factor	CF_1	kg/mg	1E-06
Exposure frequency, soil-sediment	$EF_{soil\text{-}sed}$	days/year	104
Daily Intake Factor - carcinogenic (ingestion)	$I_{factor\text{-}soil\text{-}i}$	$days^{-1}$	4.7E-07
Dermal Contact with Soil			
Dermal adherence factor, soil (young child)	AF_{soil}	mg/cm^2	0.09
Skin surface area exposed (young child)	SA	cm^2/day	3280
Fraction of intake that is site-related	$FI_{soil\text{-}sed}$	% as fraction	1.0
Fraction of total intake that is soil	F_{soil}	% as fraction	0.5
Dermal absorption factor for soil and sediment	ABS_d	% as fraction	0.03
Conversion factor, dermal con (kg/mg)	CF_1	kg/mg	1.E-06
Exposure frequency, soil-sediment	$EF_{soil\text{-}sed}$	days/year	104
Daily Intake Factor - carcinogenic (dermal)	$I_{factor\text{-}soil\text{-}d}$	$days^{-1}$	6.6E-08
CARCINOGENIC			**Child**
Daily Intake Factor, dermal contact $(days)^{-1}$			6.6E-08
Daily Intake Factor, soil ingestion $(days)^{-1}$			4.7E-07
Tolerable Daily Intake (TDI) (mg/kg-day)			2.30E-09
Conversion Factor (ng/mg)			1.00E+06
Target Hazard Quotient			1
PCL Soil (ng/kg)			**4,299**

Table H9
Summary of Cancer Hazard Based PCLs (ng/kg) for $TEQ_{DF,M}$

Constituent	Exposure Pathway	Recreational Fisher		Subsistence Fisher	Recreational Visitor	
		RME	CTE		RME	CTE
$TEQ_{DF,M}$	Fish Tissue	12	88	1.5	--	--
	Shellfish Tissue	291	1,840	22	--	--
	Sediment	981	11,433	368	736	5,716
	Soil	--	--	--	4,299	226,904

Table H14
Noncancer Hazard Based PCLs for $TEQ_{DF,M}$ in Sediment for Hazard Index of 1, RME Scenario

Parameter		Units	Hypothetical Recreational Fisher	Hypothetical Subsistence Fisher	Hypothetical Recreational Visitor
Common Parameters					
Exposure duration (young child)	ED	years	6	6	6
Body weight (young child)	BW	kg	19	19	19
Averaging time - noncarcinogenic (young child)	AT_n	days	2,190	2,190	2,190
Pathway Specific Parameters					
Incidental Ingestion of Sediment					
Ingestion rate, sediment (young child)	IR_{sed}	mg/day	125	125	125
Fraction of intake that is site-related	$FI_{soil\text{-}sed}$	% as fraction	1.00	1.00	1.00
Fraction of total intake that is sediment	F_{sed}	% as fraction	1.00	1.00	0.50
Relative bioavailability adjustment for soil and sedimer	RBA_{ss}	% as fraction	0.50	0.50	0.50
Conversion factor	CF_1	kg/mg	1E-06	1E-06	1E-06
Exposure frequency, soil-sediment	$EF_{soil\text{-}sed}$	days/year	39	104	104
Daily Intake Factor - noncarcinogenic (ingestion)	$I_{factor\text{-}sed\text{-}i}$	$(days)^{-1}$	3.5E-07	9.4E-07	4.7E-07
Dermal Contact with Sediment					
Dermal adherence factor, sediment (young child)	AF_{sed}	mg/cm^2	3.6	3.6	3.6
Skin surface area exposed (young child)	SA	cm^2/day	3,280	3,280	3,280
Fraction of intake that is site-related	$FI_{soil\text{-}sed}$	% as fraction	1.00	1.00	1.00
Fraction of total intake that is sediment	F_{sed}	% as fraction	1.00	1.00	0.50
Dermal absorption factor for soil and sediment	ABS_d	% as fraction	0.03	0.03	0.03
Conversion factor, dermal con (kg/mg)	CF_1	kg/mg	1.E-06	1.E-06	1.E-06
Exposure frequency, soil-sediment	$EF_{soil\text{-}sed}$	days/year	39	104	104
Daily Intake Factor - noncarcinogenic (dermal)	$I_{factor\text{-}sed\text{-}d}$	$(days)^{-1}$	2.0E-06	5.3E-06	2.7E-06
NONCARCINOGENIC			**Child**	**Child**	**Child**
Daily Intake Factor, dermal contact $(days)^{-1}$			2.0E-06	5.3E-06	2.7E-06
Daily Intake Factor, sediment ingestion $(days)^{-1}$			3.5E-07	9.4E-07	4.7E-07
Reference Dose (RfD) (pg/kg-day)			7.00E-01	7.00E-01	7.0E-01
Conversion Factor (pg/ng)					1.0E+03
Target Hazard Index			1	1	1
PCL Sediment (ng/kg)			**299**	**112**	**224**

Table H16
Noncancer Hazard Based PCLs for $TEQ_{DF,M}$ in Soil for Hazard Index of 1, RME Scenario

Parameter		Units	Hypothetical Recreational Visitor
Common Parameters			
Exposure duration (young child)	ED	years	6.0
Body weight (young child)	BW	kg	19
Averaging time - noncarcinogenic (young child)	AT_n	days	2,190
Pathway Specific Parameters			
Incidental Ingestion of Soil			
Ingestion rate, soil (young child)	IR_{soil}	mg/day	125
Fraction of intake that is site-related	$FI_{soil\text{-}sed}$	% as fraction	1.00
Fraction of total intake that is soil	F_{soil}	% as fraction	0.50
Relative bioavailability adjustment for soil and sediment	RBA_{ss}	% as fraction	0.50
Conversion factor	CF_1	kg/mg	1E-06
Exposure frequency, soil-sediment	$EF_{soil\text{-}sed}$	days/year	104
Daily Intake Factor - noncarcinogenic (ingestion)	$I_{factor\text{-}soil\text{-}i}$	$(days)^{-1}$	4.7E-07
Dermal Contact with Soil			
Dermal adherence factor, soil (young child)	AF_{soil}	mg/cm^2	0.09
Skin surface area exposed (young child)	SA	cm^2/day	3,280
Fraction of intake that is site-related	$FI_{soil\text{-}sed}$	% as fraction	1.0
Fraction of total intake that is soil	F_{soil}	% as fraction	0.5
Dermal absorption factor for soil and sediment	ABS_d	% as fraction	0.03
Conversion factor, dermal con (kg/mg)	CF_1	kg/mg	1.E-06
Exposure frequency, soil-sediment	$EF_{soil\text{-}sed}$	days/year	104
Daily Intake Factor - noncarcinogenic (dermal)	$I_{factor\text{-}soil\text{-}d}$	$(days)^{-1}$	6.6E-08
NONCARCINOGENIC			**Child**
Daily Intake Factor, dermal contact $(days)^{-1}$			6.6E-08
Daily Intake Factor, soil ingestion $(days)^{-1}$			4.7E-07
Reference Dose (RfD) (pg/kg-day)			7.00E-01
Conversion Factor (pg/ng)			1.00E+03
Target Hazard Index			1
PCL Soil (ng/kg)			**1,308**

Table H38
Summary of Risk-Based PCLs for Noncancer Endpoint

Constituent	Exposure Pathway	Recreational Fisher		Subsistence Fisher	Recreational Visitor	
		RME	CTE		RME	CTE
TEQ_{DF} (ng/kg)	Fish Tissue	3.8	27	0.44	NA	NA
	Shellfish Tissue	89	560	6.65	NA	NA
	Sediment	299	3,479	112	224	1,740
	Soil	NA	NA	NA	1,308	69,058
Total PCBs (µg/kg)	Fish Tissue	109	762	13	NA	NA
	Shellfish Tissue	2,533	16,000	190	NA	NA
	Sediment	2,000	21,438	750	1,500	10,719
	Soil	NA	NA	NA	16,036	564,474
Arsenic (mg/kg)	Fish Tissue	16	114	1.9	NA	NA
	Shellfish Tissue	380	2,400	28.5	NA	NA
	Sediment	128	1,491	48	6.4	746
	Soil	NA	NA	NA	561	29,596
Mercury (mg/kg)	Fish Tissue	0.5	3.8	0.06	NA	NA
	Shellfish Tissue	13	80.0	1.0	NA	NA

Table H-56

Cancer Hazard Based PCLs for $TEQ_{DF.M}$ in Soil for Hazard Index of 1, RME Scenario

Parameter		Units	Hypothetical Future Construction Worker
Common Parameters			
Exposure duration	ED	years	1
Body weight	BW	kg	80
Averaging time	AT	days	365
Pathway Specific Parameters			
Incidental Ingestion of Soil			
Soil ingestion rate	IR_{soil}	mg/day	330
Fraction of intake that is site-related	FI	% as fraction	1.00
Relative bioavailability adjustment for soil	RBA_{soil}	% as fraction	0.50
Conversion factor	CF_1	kg/mg	1E-06
Exposure frequency	EF	days/year	250
Daily Intake Factor - ingestion	$I_{factor\text{-}soil\text{-}i}$	$days^{-1}$	1.4E-06
Dermal Contact with Soil			
Dermal adherence factor, soil	AF_{soil}	mg/cm^2	0.2
Skin surface area exposed	SA	cm^2	2,630
Fraction of intake that is site-related	FI	% as fraction	1.00
Dermal absorption factor for soil	ABS_d	% as fraction	0.03
Conversion factor, dermal con (kg/mg)	CF_1	kg/mg	1.E-06
Event frequency	EV	day^{-1}	1
Exposure frequency, soil	EF	days/year	250
Daily Intake Factor - dermal	$DAD_{factor\text{-}soil}$	$days^{-1}$	1.4E-07
CARCINOGENIC			**Adult**
Daily Intake Factor, dermal contact	$DAD_{factor\text{-}soil}$	$days^{-1}$	1.4E-07
Daily Intake Factor, soil ingestion	$I_{factor\text{-}soil\text{-}i}$	$days^{-1}$	1.4E-06
Tolerable Daily Intake	TDI	mg/kg-day	2.30E-09
Conversion factor (ng/mg)	CF_2	ng/mg	1.00E+06
Target Hazard Index	THI	unitless	1
PCL Soil (ng/kg)			**1,500**

Table H-58
Noncancer Hazard Based PCLs for $TEQ_{DF,M}$ in Soil for Hazard Index of 1, RME Scenario

Parameter		Units	Hypothetical Future Construction Worker
Common Parameters			
Exposure duration	ED	years	1
Body weight	BW	kg	80
Averaging time	AT	days	365
Pathway Specific Parameters			
Incidental Ingestion of Soil			
Soil ingestion rate	IR_{soil}	mg/day	330
Fraction of intake that is site-related	FI	% as fraction	1.00
Relative bioavailability adjustment for soil	RBA_{soil}	% as fraction	0.50
Conversion factor	CF_1	kg/mg	1E-06
Exposure frequency	EF	days/year	250
Daily Intake Factor - ingestion	$I_{factor\text{-}soil\text{-}i}$	$days^{-1}$	1.4E-06
Dermal Contact with Soil			
Dermal adherence factor, soil	AF_{soil}	mg/cm^2	0.2
Skin surface area exposed	SA	cm^2	2,630
Fraction of intake that is site-related	FI	% as fraction	1.00
Dermal absorption factor for soil	ABS_d	% as fraction	0.03
Conversion factor, dermal con (kg/mg)	CF_1	kg/mg	1.E-06
Event frequency	EV	day^{-1}	1
Exposure frequency, soil	EF	days/year	250
Daily Intake Factor - dermal	$DAD_{factor\text{-}soil}$	$days^{-1}$	1.4E-07
NONCARCINOGENIC			**Adult**
Daily Intake Factor, dermal contact	$DAD_{factor\text{-}soil}$	$days^{-1}$	1.4E-07
Daily Intake Factor, soil ingestion	$I_{factor\text{-}soil\text{-}i}$	$days^{-1}$	1.4E-06
Reference Dose	RfD	mg/kg-day	7.0E-10
Conversion factor (ng/mg)	CF_2	ng/mg	1.00E+06
Target Hazard Index	THI	unitless	1
PCL Soil (ng/kg)			**450**

ATTACHMENT C

Integral used the method described by USEPA (1991) guidance to derive PCLs. USEPA (1991) guidance provides a method for calculation of PCLs to address all assumed pathways of direct exposure to a single environmental medium (such as sediment, soil, or tissue). The guidance does not require that combined exposures to more than one environmental medium be considered. Consideration of combined exposures in deriving PCLs creates significant computational complexity and may require *a priori* decisions about relative risk reductions in different media. Decisions about risk reduction must be conducted independently for each medium in order to evaluate all of the required decision factors in the FS.

A summary of PCL results for sediment is provided in Tables 5-29 and 5-30. A summary of PCLs for soil is provided in Tables 5-31 and 5-32 while a summary of PCL results for tissue is provided in Tables 5-33 and 5-34. The exposure assumptions used in evaluating risk for the hypothetical scenarios described above and summarized in the tables provided the basis for PCL calculations, but were simplified to isolate the subject media. Methods for PCL calculations are detailed below. Specific assumptions for each calculation are tabulated in Appendix H.

5.8.1 Sediment PCLs for Human Health

Hypothetical sediment exposure routes addressed by the BHHRA include ingestion of sediment and dermal contact with sediment. Human health-based PCLs for sediment were developed for the hypothetical recreational fisher scenario, hypothetical subsistence fisher scenario, and hypothetical recreational visitor scenario. Dioxins and furans expressed as $TEQ_{DF,M}$ are the primary COCs for all three scenarios, resulting in estimated cancer and noncancer hazards higher than 1 for the RME analyses. Estimated risks from exposure to total PCBs in sediment are associated with a noncancer hazard higher than 1 for the hypothetical subsistence fisher scenario, and an estimated cancer risk level higher than $1x10^{6}$ for both the recreational fisher and recreational visitor scenarios. Finally, arsenic in sediment results in estimated cancer risk levels that exceed $1x10^{-6}$. Results of risk modeling for this RI do not necessarily indicate that adverse effects on human health would have occurred under baseline conditions, or that they did or could have occurred.

PCLs for the estimated noncancer hazards and cancer hazards for COCs addressed in this section are based on potential hypothetical RME exposures for young children, the age group with the highest potential cancer hazard or noncancer hazard in all scenarios evaluated. The exposure assumptions and equations used for developing PCLs for sediment are the same assumptions used for the deterministic risk assessment in the BHHRA. Assumed direct contact, including assumed incidental ingestion and dermal contact, was evaluated for all three scenarios. The results of risk modeling for direct contact pathways for this RI cannot be interpreted to indicate that adverse effects on human health would have or could have occurred under baseline conditions.

PCLs for the COCs identified as contributing estimated cancer risks that exceed a $1x10^{-6}$ risk level have been calculated based on potential hypothetical, combined RME exposures to young children, older children, and adults. The exposure assumptions and equations used for developing PCLs for sediment are the same as the assumptions and equations used for the deterministic risk assessment in the BHHRA for cancer risk and include incidental ingestion and dermal contact for all three age groups and all three scenarios.

In addition, PCLs based on the CTE were developed for the hypothetical recreational fisher and hypothetical recreational visitor scenarios. As in the BHHRA, the CTE analyses for these scenarios assumed that only adults would be present under typical conditions. Thus, the CTE PCLs are based on hypothetical adult exposures only. No CTE analysis was completed in the BHHRA for the hypothetical subsistence fisher scenario because that scenario is, by definition, an upper-bound estimate.

PCLs can be calculated a number of ways (USEPA 1991). The simplest approach is to use the equations used for the risk assessment to estimate sediment intake under the hypothetical conditions associated with a particular scenario to derive a total estimate of exposure for all pathways combined. When the EPC is combined with the total estimate of exposure and compared with the appropriate chemical-specific toxicity criterion, an HI for either the cancer hazard or noncancer hazard for the hypothetical exposure scenario can be calculated as follows:

$$\text{HI} = C_{sed} * \left(I_{factor\_sed} + DAD_{factor\_sed}\right) * \frac{1}{RfD\ or\ TDI} \qquad \text{(Eq. 5-2)}$$

where:

C_{sed} = Exposure point concentration in sediment (mg/kg)

I_{factor_sed} = Daily intake factor due to incidental ingestion of sediment (day^{-1})

DAD_{factor_sed} = Daily intake factor for dermal absorption due to dermal contact (day^{-1})

RfD = Chemical-specific noncancer reference dose (mg/kg-day)

TDI = Cancer-based tolerable daily intake for $TEQ_{DF,M}$ (mg/kg-day)

HI = Noncancer or cancer hazard index for the combined pathways

I_{factor_sed} and DAD_{factor_sed} are calculated using the following equations:

$$I_{factor\_sed} = \frac{IR_{sed} * RBA_{sed} * FI_{sed} * EF_{sed} * ED * CF_1}{BW * AT} \quad \text{(Eq. 5-3)}$$

and

$$DAD_{factor\_sed} = \frac{AF_{sed} * ABS_d * CF_1 * SA * EF_{sed} * FI_{sed} * ED * EV}{BW * AT} \quad \text{(Eq. 5-4)}$$

where:

IR_{sed} = sediment ingestion rate (mg/day)

RBA_{sed} = relative bioavailability adjustment for sediment (percent as fraction)

FI_{sed} = fraction of total daily sediment intake that is Site-related (percent as fraction)

EF_{sed} = exposure frequency (days/year)

ED = exposure duration (years)

CF_1 = conversion factor ($1x10^{-6}$ kg/mg)

BW = body weight (kg)

AT = averaging time (days)

AF_{sed} = adherence factor for sediment (mg/cm^2)

ABS_d = dermal absorption factor for sediment (percent as fraction)

SA = skin surface area available for contact (cm^2)

EV = event frequency (day^{-1})

The PCL is simply the EPC (C_{sed}) that results in the target HI of 1 for exposures via sediment only. Thus, Equation 5-2 can be used but rearranged to solve for the PCL as follows:

$$PCL = THI * (RfD\ or\ TDI)/(I_{factor\_sed} + DAD_{factor\_sed}) \quad \text{(Eq. 5-5)}$$

where:

THI = Target noncancer or cancer hazard index of 1

A similar approach can be used for the cancer risk calculation. In this case, the risk equation is rearranged to include the CSF for the COC as follows:

$$PCL = Target\ Risk/(CSF * (I_{factor_{sed}} + DAD_{factor_{sed}})) \quad \text{(Eq. 5-6)}$$

where:

Target Risk = Target risk level within USEPA's target risk range ($1x10^{-6}$, $1x10^{-5}$ or $1x10^{-4}$)

CSF = Chemical specific cancer slope factor $(mg/kg\text{-}day)^{-1}$

The specific exposure assumptions and chemical-specific parameters used to calculate the sediment PCLs for the three scenarios of interest are provided in Appendix H.

Results of this analysis for total PCBs, $TEQ_{DF,M}$, and arsenic are summarized in Tables 5-29 and 5-30. Noncancer PCLs were calculated for all identified COCs for all three hypothetical exposure scenarios. Cancer-hazard-based PCLs for $TEQ_{DF,M}$ and cancer-risk-based PCLs for total PCBs and arsenic were calculated for all three hypothetical exposure scenarios.

5.8.2 Soil PCLs for Human Health

For the BHHRA, the hypothetical recreational and subsistence fisher scenarios are assumed to involve direct contact only with sediments in the beach areas, but the hypothetical recreational visitor scenario assumes contact with a combination of soils throughout the area north of I-10 and sediments in specific beach areas on each day of exposure. Only one of the

hypothetical recreational visitor scenarios evaluated, Hypothetical Recreational Visitor Scenario 3, results in risk estimates that are higher than the upper-bound $1x10^{-4}$ risk threshold discussed in the BHHRA. This scenario evaluated exposure through direct contact with soils throughout the area north of I-10 and the sediments in Beach Area E (i.e., the impoundments north of I-10). Although the risk and hazard thresholds are exceeded in this scenario, direct contact with soil from areas north of I-10 contributes less than 0.1 percent of the total estimated cancer and noncancer hazard for this potential receptor and total noncancer and cancer hazards due to assumed direct contact with soil are all well below the HI of 1 and cancer risk of $1x10^{-6}$ thresholds.

Nevertheless, because exposures to recreational visitors include exposure to a combination of soil and sediment, PCLs for direct contact with $TEQ_{DF,M}$, PCBs, and arsenic in soils were derived for this scenario based on the related exposure parameters used in the deterministic risk assessment. Results of this analysis are presented in Tables 5-31 and 5-32. The RME and CTE exposure parameters used to derive them are presented in Appendix H.

5.8.3 Tissue PCLs for Human Health

Tissue PCLs differ from PCLs for soil and sediment because direct remediation of fish and shellfish is not possible as it is for abiotic media, so tissue PCLs cannot generally be regarded as a goal of direct remediation. Human health-based PCLs for catfish fillet and clam tissues were developed for the hypothetical recreational fisher RME and hypothetical subsistence fisher scenarios. $TEQ_{DF,M}$ was a risk driver for both noncancer and cancer hazard. Total PCBs and arsenic were the risk drivers for cancer risk, and $TEQ_{DF,M}$, total PCBs, arsenic, and mercury were risk drivers when noncancer hazards were considered. Results of risk modeling for this RI do not necessarily indicate that adverse effects on human health would have occurred under baseline conditions or that they did or could have occurred.

As for the sediment PCLs, the tissue RME PCLs for the cancer hazard and noncancer hazard are based on assumed potential fish or shellfish consumption by a young child, as this category represents the age group with the highest potential cancer and noncancer hazards based on the hypothetical assumed exposure conditions for the applicable scenario. For the cancer-risk-based PCL calculation, potential fish or shellfish consumption by young

children, older children, and adults, combined, were considered. PCLs based on CTE exposures consider potential exposures to adults only.

To calculate the PCLs for tissue based on cancer hazard or noncancer hazard, an approach similar to the one outlined for sediment PCLs was used. The estimated daily intake via fish or shellfish tissue consumption was calculated without the EPC using the following equation:

$$I_{factor\_tissue} = \frac{IR_{tissue} \times RBA_{tissue} \times FI_{tissue} \times (1 - LOSS) \times EF_{tissue} \times ED \times CF_2}{BW \times AT} \qquad \text{(Eq. 5-7)}$$

where:

I_{factor_tissue}	=	the estimated exposure from ingestion of fish or shellfish tissue by the receptor per unit body weight per unit time (1/day)
IR_{tissue}	=	fish or shellfish ingestion rate (g/day)
RBA_{tissue}	=	relative bioavailability adjustment for tissue (percent as fraction)
FI_{tissue}	=	fraction of total fish or shellfish intake that is site-related (percent as fraction)
LOSS	=	chemical reduction due to preparation and cooking (percent as fraction)
EF_{tissue}	=	exposure frequency for fish or shellfish consumption (days/year)
ED	=	exposure duration (years)
CF_2	=	conversion factor ($1x10^{-3}$ kg/g)
BW	=	body weight (kg)
AT	=	averaging time (days)

Then the PCL was calculated using the following equation:

$$PCL_{tissue} = THI * (RfD \text{ or } TDI)/I_{factor\_tissue} \qquad \text{(Eq. 5-8)}$$

When calculating PCLs for PCBs and arsenic based on potential cancer risk, a similar approach was used but the risk calculation was rearranged to solve for the PCL using the CSF, as follows:

$$PCL_{tissue} = Target\ Risk/(CSF * I_{factor\_tissue}) \quad \text{(Eq. 5-9)}$$

A summary of tissue $TEQ_{DF,M}$ PCLs for tissue is provided in Table 5-33 and those for total PCBs, arsenic, and mercury are provided in Table 5-34. Detailed exposure assumptions and equations used for developing PCLs for fish and shellfish tissues are the same assumptions used for the deterministic risk assessment. These are presented in Appendix H.

5.8.4 Comparison of PCLs to Baseline, Post-TCRA, and Background Concentrations for Human Exposure

The PCLs as calculated above were compared to concentrations of COCs that represent baseline conditions, post-TCRA conditions, or background exposure concentrations for perspective on the status of the post-TCRA conditions relative to baseline, and relative to background. Table 5-35 compares PCLs developed for $TEQ_{DF,M}$ in sediments to the post-TCRA EPC used for the human health risk assessment and sediment surface area-weighted average concentrations (SWACs) for FCAs 1 and 2/3. The post-TCRA EPC of 0.456 ng/kg falls well below the noncancer PCLs calculated for the hypothetical recreational fisher (300 ng/kg), hypothetical subsistence fisher (110 ng/kg), and hypothetical recreational visitor (220 ng/kg). In addition the SWACs for FCA 1 and FCA 2/3 fall below the calculated PCLs for all receptor groups. This indicates that under post-TCRA conditions, concentrations of $TEQ_{DF,M}$ in sediment would not be considered by USEPA to be a human health risk concern.

Table 5-36 compares PCLs developed for $TEQ_{DF,M}$, arsenic, mercury, and PCBs in catfish fillet and clams to EPCs for these media under baseline and background conditions. Because empirical data to describe tissue under post-TCRA conditions are not available, post-TCRA tissue concentrations are not included in this comparison. With the exception of $TEQ_{DF,M}$, the EPCs for all COCs in catfish were below the PCLs calculated for recreational fishers. The RME EPCs for $TEQ_{DF,M}$ in catfish fillet at FCA 1 and FCA 2/3 were 3.92 ng/kg ww and 4.06 ng/kg ww, respectively. These EPCs were only slightly elevated above the hypothetical recreational fisher noncancer PCL of 3.8 ng/kg ww for $TEQ_{DF,M}$. For clam tissue, only the EPC for $TEQ_{DF,M}$ in FCA 2 exceeded the noncancer PCL calculated for the hypothetical subsistence fisher. The EPC for $TEQ_{DF,M}$ in clams is 19 ng/kg ww, and is approximately three-fold higher than the PCL calculated for hypothetical subsistence fishers of 6.7 ng/kg ww.